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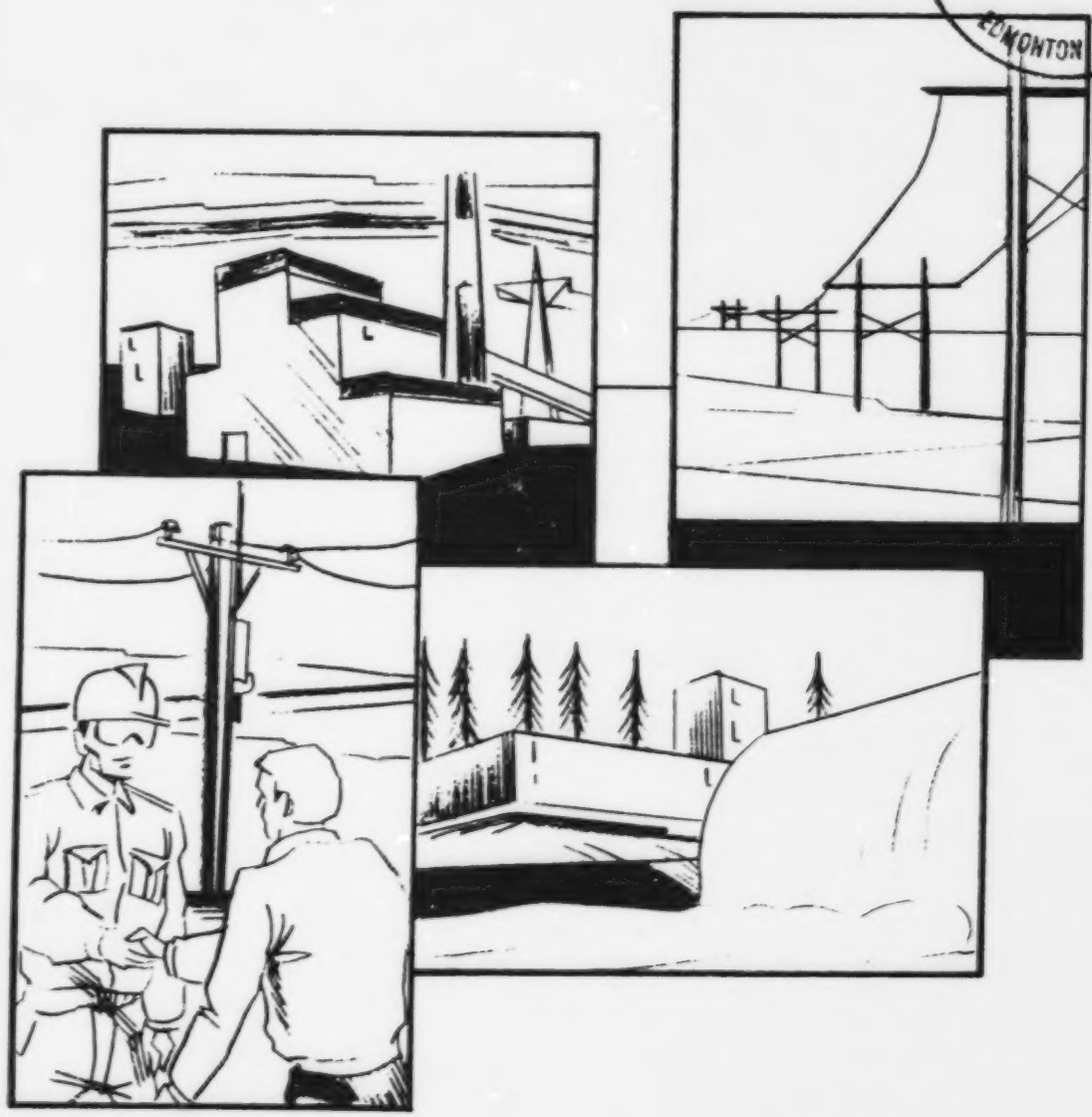

A Discussion Paper Prepared for the Alberta Conservation Strategy Project

Electricity:

Development For A Sustainable Future

Prepared by

Electric Utility Planning Council (EUPC)

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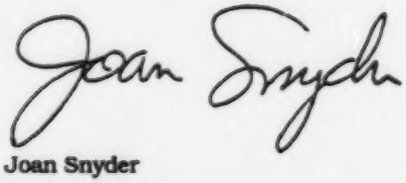
FOREWORD

In late 1985, the Public Advisory Committees to the Environment Council of Alberta began working toward a draft conservation strategy for Alberta. The Public Advisory Committees (PACs), comprising representatives of some 120 non-government organizations, are in many ways an ideal organization for developing a strategy that should touch the lives of all Albertans. The PACs bring together many diverse viewpoints. We are non-partisan, and we have members from across the province. Since the early days of the project, we have welcomed non-PAC participants, and have been delighted to receive the contributions of civil servants, industry spokespeople, academics, and the general public.

We have made much progress since 1985: the *Prospectus for an Alberta Conservation Strategy* was published in 1987 and many meetings and workshops have been held; sixteen sectoral discussion papers have been released; and in 1990, the *Alberta Conservation Strategy — Framework for Action* and the *Framework in Brief* were published. These publications have been presented, for consideration, to the Alberta Round Table on Environment and Economy which is charged with preparing a sustainable development strategy for Alberta.

This paper, *Electricity: Development For A Sustainable Future*, is the 17th in the series of discussion papers. Unlike others published to date, this paper was prepared by an industrial organization, the Electric Utility Planning Council. While the Steering Committee recognizes the important contribution this paper makes to the discussion surrounding conservation and sustainable development in Alberta, responsibility for the content rests with the Electric Utility Planning Council.

Because there are as many opinions on our best future direction as there are Albertans, we welcome comments. Alberta's strategy will be only as good as the work that goes into preparing it. Please send any comments on this discussion paper or others in the series, or the *Framework for Action*, to the Environment Council of Alberta at the address given on the page opposite. I would also encourage you to make your opinions known at public hearings, consultations, or other events which relate to sustainable use of our resources. Let's treat Alberta as if we plan to stay!



Joan Snyder
Chairperson
Conservation Strategy Steering Committee
Public Advisory Committees to the Environment Council of Alberta

Preface

In presenting this discussion paper to the Alberta Conservation Strategy, the Electric Utility Planning Council (EUPC) recognizes the importance of a sustainable future — a future in which society achieves two important and interlinking goals:

1. Identifying and meeting the energy requirements for long-term economic stability and growth in the province.
2. Identifying the environmental impacts of using energy and ensuring our ecosystems can absorb them.

In this paper, the EUPC's focus is primarily the first of these goals. The submission provides background information on the role that electricity plays in Alberta's economy, the sources from which it is currently generated and the options most immediately available for the future.

This report is based on information available to the EUPC at a specific time, and represents a snapshot of the electric industry as of the late 1980s. However, the technologies and issues associated with electricity development are constantly changing. Should public hearings be held on a conservation strategy for Alberta at some point in the future, the EUPC will update the information in this report to be as relevant as possible to the discussions at that time.

In the meantime, the EUPC's member utilities are, on an individual basis, doing a considerable amount of work on the second goal. They are working to understand and promote various technologies, to engage in consultation processes and develop policy instruments that will encourage sustainability in both senses. This is also an area where our knowledge is continually growing and new options are emerging.

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Chapter One

Executive Summary

Principles

The electric utility industry in Alberta endorses the concept of a Conservation Strategy for the province. The concept of conservation embraces preservation, maintenance and enhancement of the natural environment. It embraces the idea of stewardship: protecting resources, using them in a sustainable manner (keeping as many options open as possible), and passing them on to future generations.

Electric utilities play an important role in the use and conservation of energy resources. Historically, Alberta's economic development has been based on the province's natural resources. Not only has the availability of electric power made resource development possible, but the generation of electricity also requires a substantial commitment of such resources in itself.

Sustainable economic development is necessary in order to create jobs and retain opportunities for all Albertans, both today and in the future. Alberta's electric utilities believe it is essential to address the continued development of our economic base without unnecessarily depleting the non-renewable resources or damaging the renewable resources on which we and future generations depend.

The industry believes Albertans will be best served by a conservation strategy that allows for prudent development of renewable and non-renewable energy resources when they are required, rather than a strategy aimed at absolute conservation of non-renewable resources. The conservation strategy must be determined by acceptable standards of environmental quality and energy requirements, but must be flexible and open for future change.

Electricity and the Alberta Economy

The electric utility business in Alberta is driven primarily by consumer demand for electric power. Ever since electricity was introduced into homes at the end of the nineteenth century, it has become indispensable. This versatile source of energy has contributed significantly to the development of Alberta's economy, to the point where nearly four-fifths of all the electricity sold in the province is used by the industrial and commercial sectors.

The Alberta economy is dominated by a large natural resource sector with significant, complementary activity in the manufacturing and service sector. The key resources are crude oil and natural gas. Coal, agriculture and forest resources are also substantial. The reliance on resource-based industries, where commodity prices and profit levels have historically been volatile, has resulted in wide swings in Alberta's economic growth.

Nevertheless, the consumption of electricity has shown consistently strong increases as the economy has become more electricity-intensive. There are considerable uncertainties in forecasting the province's future requirements for electricity. The Electric Utility Planning Council's (EUPC) most recent forecasts, indicate a variety of scenarios in which growth in demand ranges between 2.4 percent and 4.4 percent a year to the end of the century. This is lower than growth rates throughout the 1980s, which have averaged more than 5 percent.

Growth in electric demand can be managed to some extent through energy pricing, education and conservation measures. However, even with stringent conservation measures in effect, the

demand for electricity will increase as the province's economy grows and develops. A conservation strategy that takes this fact into account will best serve Alberta in the future.

In serving the needs of Alberta's other industries, the electric industry generates considerable economic activity in its own right. The province's electric utilities directly employ approximately 7000 Albertans. Currently, we export very little power, although the potential exists for expanding this contribution to the province's economic base.

Achieving Sustainable Economic Development

The unique convenience of electricity leads most people to overlook the enormous efforts required to generate, transmit and distribute power to homes, businesses and industries. However, electricity is a secondary energy supply generated from a primary resource. In the case of water power, this resource is renewable, but in the case of coal, oil and gas, energy is drawn from a depleting supply.

More than 90 percent of Alberta's electricity is generated by coal-fired power plants. The province has abundant reserves of low-sulphur, sub-bituminous coal. There is some potential for additional hydro development although most sites are not considered economic at this time.

Any conservation strategy for Alberta should recognize the prudent use of non-renewable energy resources, together with technological advancement so that sustainable development can be achieved. The mandate of Alberta utilities to provide electricity at the "lowest practical cost" should be interpreted to include consideration of environmental and social costs.

The low cost and availability of coal is expected to make it the main source of Alberta's electric generation in the foreseeable future. The low cost of gas turbine capacity is expected to make it the main source of peaking and reserve capacity, in spite of the expectation that gas prices will increase.

Alternative resources such as wind, small hydro, solar power and biomass may well come to play a more significant role in meeting the province's electric needs in the future. An important factor in meeting future electric needs will also be the ability to reduce overall demand through conservation and demand-side management strategies.

The province's utilities are continuing to monitor and explore new technologies, including those that will make coal more acceptable from an environmental point of view.

Utilities and the Environment

The province's utilities recognize the concern many Albertans have about the environment. The electric industry undoubtedly has impacts on the environment, particularly in connection with the generation of power.

Environmental concerns in Alberta have tended to centre on such issues as the emission of acid-forming gases from coal-fired plants; the land-use requirements involved in mining coal; and the phasing-out of PCBs in electrical equipment. As well, there are emerging (and highly controversial) issues such as the possibility that human health is affected by electric and magnetic fields and the relation between carbon dioxide from fossil fuels and global warming.

The EUPC's member utilities have already taken significant steps (both in terms of the investment involved and the impact those steps have had) to minimize the impacts of utility operations.

For example, the utilities have instituted technologies to drastically reduce flyash emissions and improve the disposal of ash. New technologies to reduce the formation of sulphur dioxide and oxides of nitrogen are being actively developed.

Mined land is now reclaimed to a level of agricultural production that is at least equal to that which existed before mining. Individual EUPC member utilities have completed, or are well on the way to completing, the phasing out of all PCB equipment. Already, equipment in locations of particular concern to the public (such as in close proximity to schools) has been removed.

Careful right-of-way planning, detailed environmental impact assessments prior to the construction of power plants, and the encouragement

of wise electric use are ways in which Alberta's utilities help protect the environment.

With respect to emerging environmental issues, Alberta's utilities continually monitor concerns, participate in research and adopt new technologies as they become available.

The public expects increasingly high standards of environmental protection. The EUPC's members recognize that meeting the basic economic need for reliable, affordable electricity must also take into account the need to protect the environment we all share.

Chapter Two

Overview of Electric Energy in Alberta

Utility Ownership

Albertans receive electric service from a combination of privately owned and municipally owned utilities. In this respect, the province differs from most others in Canada, where electric service is provided by provincially owned corporations.

Most of the province (in terms of area) is served by two investor-owned utilities, TransAlta Utilities Corporation and Alberta Power Limited. TransAlta serves the southern and central part of the province, while Alberta Power serves the northern and east-central regions. Both these companies generate and sell power directly to their own customers; TransAlta Utilities also sells power in bulk to municipally owned utilities.

The major urban areas, Edmonton and Calgary, are each served by a municipally owned utility: Edmonton Power and the City of Calgary Electric System. The cities of Medicine Hat, Red Deer and Lethbridge are also served by municipally owned systems.

Edmonton Power and the City of Medicine Hat generate electricity as well as distributing it. The other municipally owned utilities in the province — The City of Calgary Electric System, the City of Lethbridge and the City of Red Deer — do not own generating facilities, but do own the transmission and distribution systems required to serve their customers.

Facilities

While electric facilities such as generating plants and transmission lines are owned by the various utilities, the Alberta Interconnected System (AIS) operates as an integrated grid. The Alberta Interconnected System Power Pool (AISPP), of which Alberta Power, Edmonton Power and TransAlta Utilities are members, dispatches energy from the generating units owned by the three member utilities. AISPP operations are controlled through TransAlta's system control centre in Calgary.

There are approximately 70 generating units connected to the AIS, with a total of about 7000 megawatts of capacity. The large bulk of this capacity — some 4900 megawatts — comes from coal-fired units. Most of these are located in the central and southern parts of the province, to take advantage of the province's large deposits of low-cost, low-sulphur, sub-bituminous coal.

The coal-fired units provide the base load. In addition, about 800 megawatts of the grid's capacity is made up of hydro units (owned by TransAlta) that take advantage of river systems originating in the Rocky Mountains. These units are largely used for meeting peak loads, as are the two gas-fired power plants owned by Edmonton Power at Clover Bar and Rossdale, and three gas-fired plants owned by Alberta Power.

In 1986, TransAlta completed a 500-kilovolt tie line connecting the AIS to the electrical grid in British Columbia, which makes additional capacity available to Alberta as well as providing a potential market for surplus electricity.

In 1989, Alberta Power completed another tie line, this time to the Saskatchewan electric grid. This is the first time that electric grids in the eastern and western halves of the country have been linked.

In addition to the generating facilities connected to the AIS, Alberta Power owns a number of isolated generating units that serve remote communities and microwave sites in the north of the province. The Town of Jasper is an isolated system served by Alberta Power and supplied by a combination of hydro power and gas-fired units.

Regulatory Agencies

Alberta's electric utilities are regulated by two quasi-judicial bodies. Another government agency — the Alberta Electric Energy Marketing Agency (AEEMA) — is also involved in pooling costs for generation and transmission facilities owned by Alberta Power, Edmonton Power and TransAlta Utilities.

The Energy Resources Conservation Board (established in 1972 to replace the former Oil and Gas Conservation Board and the Alberta Power Commission) approves the construction of new facilities, including transmission lines and generating units.

The second quasi-judicial body, the Public Utilities Board, regulates rates charged to customers by the investor-owned utilities. (Rates for the municipally owned utilities are set by their respective city councils.) The Board holds public rate hearings to determine the revenue required by utilities to cover the costs incurred in serving customers and to determine the proportion of that revenue to be borne by various consumer groups.

The Alberta Electric Energy Marketing Agency was established in 1981 to pool generating and transmission costs for utilities throughout Alberta, thereby reducing the differential between rates charged in different parts of the province.

The Electric Utility Planning Council

The Alberta Interconnected System has grown steadily in size and complexity over the years. In 1972, recognizing the need for coordinated one-system planning, Alberta's utilities formed the Electric Utility Planning Council to co-ordinate planning for the electric system in the best interests of Albertans.

The member utilities of the EUPC include:

Alberta Power Limited
Edmonton Power
The City of Calgary Electric System
The City of Lethbridge
The City of Medicine Hat
The City of Red Deer
TransAlta Utilities Corporation.

Chapter Three

Electricity and the Alberta Economy

Overview of the Alberta Economy

The Alberta economy is dominated by a large natural resource sector with significant, complementary activity in the manufacturing and service sector. The key resources are crude oil and natural gas. Coal, agriculture and forest resources are also substantial. The reliance on resource-based industries, where commodity prices and profit levels have historically been volatile, has resulted in wide swings in Alberta's economic growth.

Figure 1 demonstrates the fact that changes in Alberta's Gross Domestic Product (GDP) have been more dramatic than those of Canada as a whole. Between 1971 and 1988, annual real growth in Alberta's GDP peaked at 11.1 percent and reached a low of -4.6 percent, while the Canadian GDP fluctuated between an annual peak of 7.7 percent and a low of -3.2 percent.

Natural resource development, in addition to being volatile, also requires large investment — which in turn can significantly influence economic growth. As Figure 2 illustrates, growth in Alberta's real investment outpaced Canadian investment growth during the 1970s and early 1980s. This strength was almost entirely related to the development of Alberta's resources. However, as oil prices moderated in the 1980s, so did investment in Alberta, pushing the provincial index of investment slightly below the national one.

Examining Figures 1 and 2 together, it is apparent that GDP and investment levels are correlated. The increased levels of investment brought about by high world oil prices clearly resulted in increased economic activity in Alberta. In turn, this increased activity had the circular effect of boosting investment in sectors not directly affected by oil prices.

As Alberta investment growth moderated with the softening of oil prices, so did GDP expansion. Nevertheless, Alberta's economic growth has generally remained positive, because of the continued growth in manufacturing and service sectors complementing growth in the oil, gas and other resource industries.

Alberta's Economic Structure and Electricity Demand

Electricity is an essential ingredient in Alberta's economy, both present and future. Without electricity, this province would be unable to function and contribute to the national economy and the international marketplace.

In keeping with the strong role of investment in Alberta's economy, the province has experienced significant growth in industrial and commercial requirements for electricity. As Figures 3 and 4 illustrate, Alberta's commercial and industrial demand for electricity has grown from about 5700 gigawatt hours in 1970 (making up 70 percent of total electricity demand) to just over 29,000 gigawatt hours (or 80 percent of the total) in 1988. The percentage of electricity used by Alberta's commercial and industrial sectors significantly exceeds the average Canadian share of 70 percent.

As Figure 5 indicates, the growth in Alberta's electricity requirements has consistently outpaced growth in GDP. In addition, electricity demand in the province has expanded more rapidly than total energy demand. In 1971,

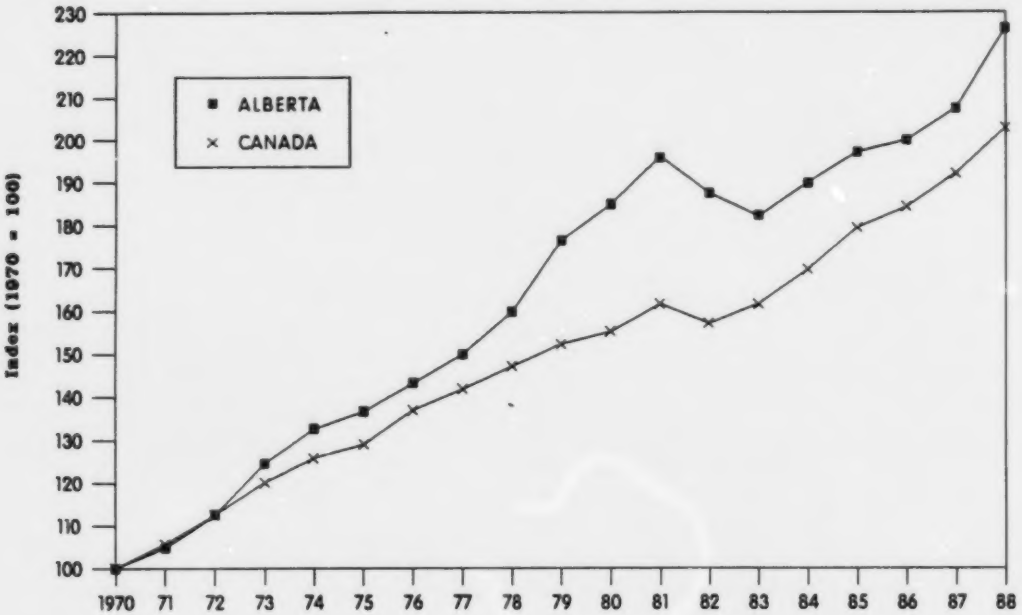

Figure 1: Gross Domestic Product

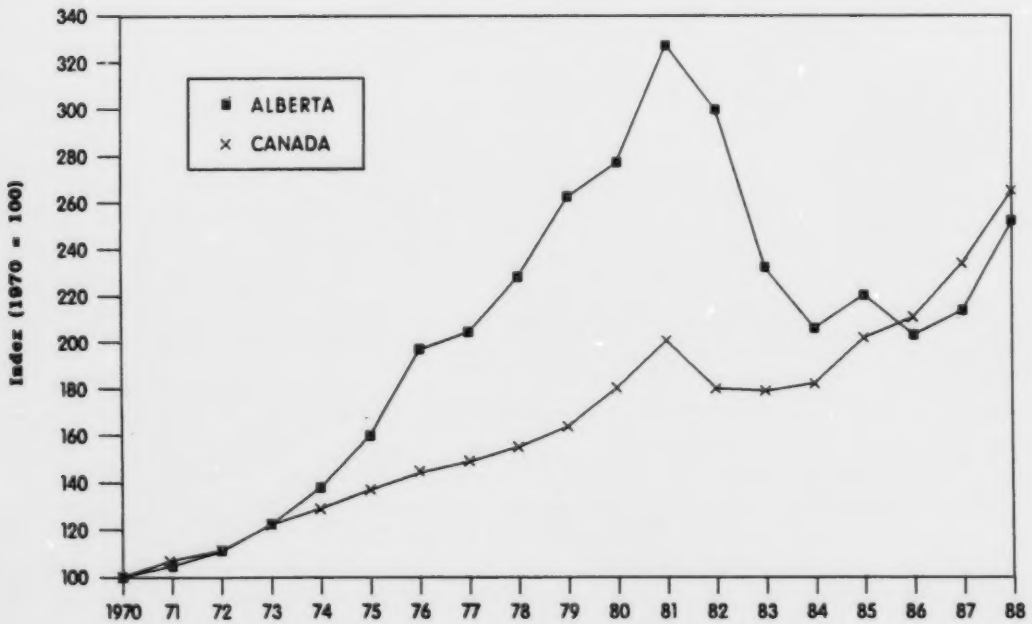

Figure 2: Investment

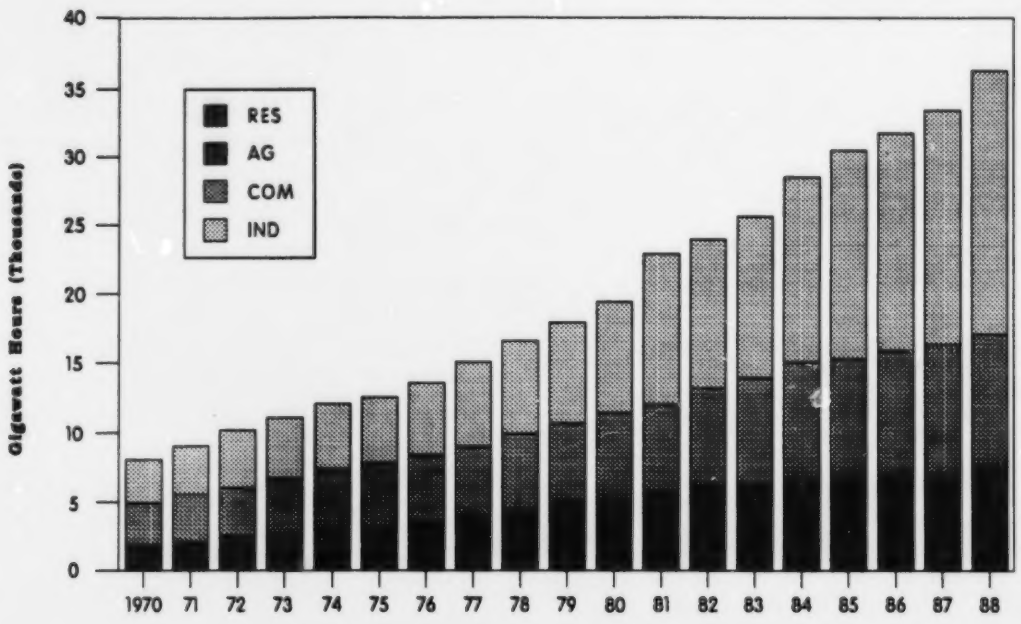

Figure 3: Alberta Electricity Demand By Sector

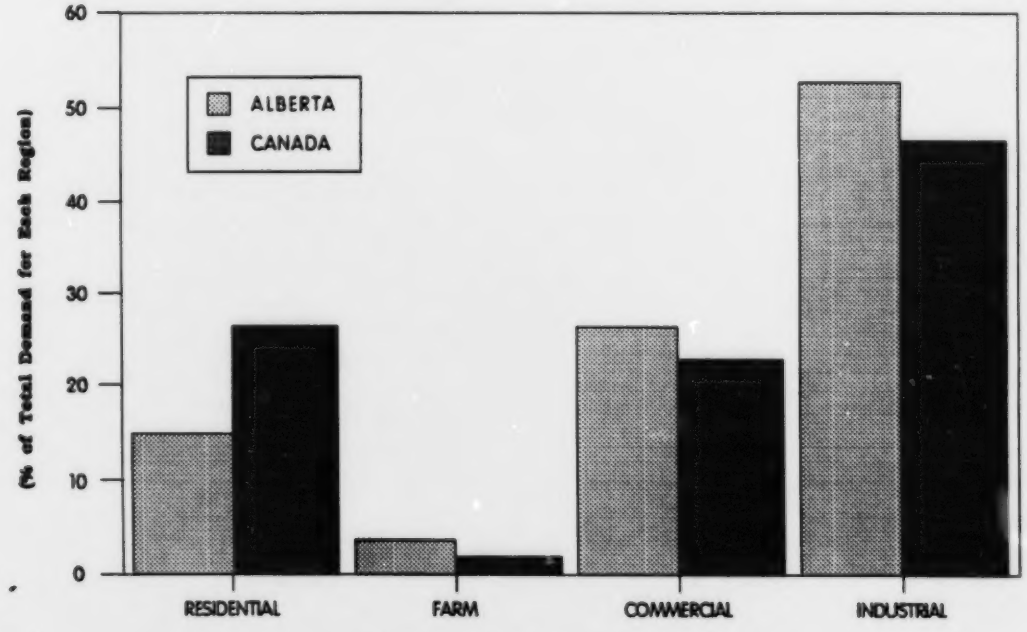

Figure 4: 1988 Electricity Demand

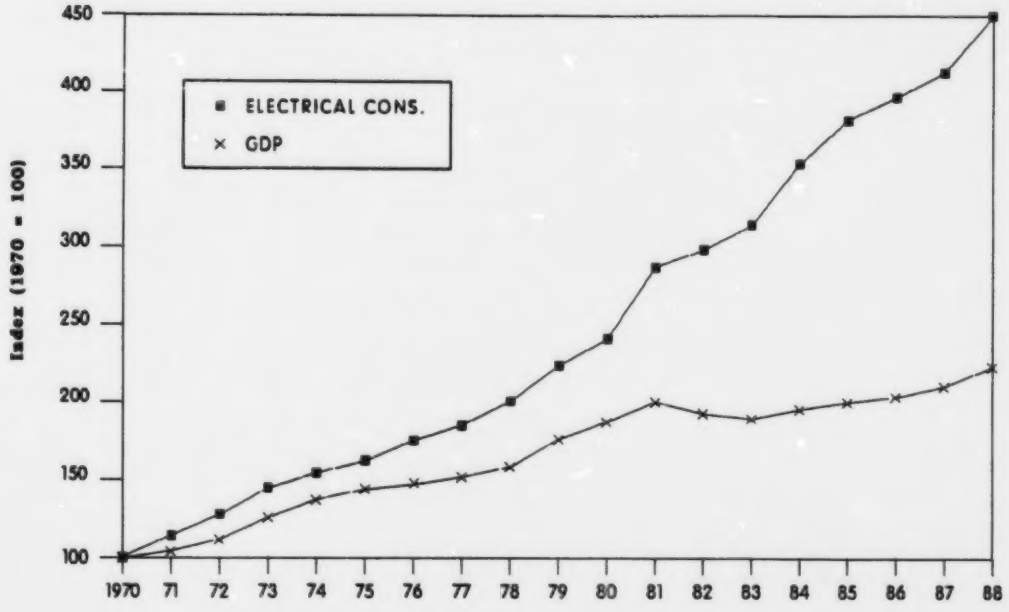

Figure 5: GDP and Electrical Consumption in Alberta

electricity made up 8.3 percent of total secondary demand; by 1988, this percentage had increased to 13.6 percent.

The Alberta economy has, therefore, steadily become more electricity-intensive as consumers have switched to electricity from other fuels and as new technologies have favored the use of electricity. Although this trend is also found at the national level, it is substantially greater in Alberta, and has caused Alberta's demand for electricity to grow at a rate almost double that of Canada as a whole.

In 1986, Alberta's electric sales totalled $1.3 billion, contributing considerably to the provincial economy and providing investors in Canada with a competitive return on their money.

Directly and indirectly, the electric utility industry provides thousands of jobs throughout Alberta. The province's utilities employ some 7000 people. Alberta's electric rates are attractive to industry, and play a role in the economic development of the province.

At this time, the electric industry contributes only in a minor way to the province's exports. However, there are growing opportunities for the export of electricity generated from our coal. The Alberta Conservation Strategy should recognize the potential for expanding the coal marketplace to make best use of our energy resources, provided such development can be carried out in a environmentally sensitive manner.

Socio-Economic Impact of Coal-Fired Plants

Coal-fired generating plants are one of the major sources of employment and related economic spin-off benefits from the electric industry. A typical 800-megawatt power plant employs approximately 130 permanent staff members. Using economic multipliers for Alberta, this translates into a total of 300 full-time jobs.

Such a plant provides extensive spin-off benefits during the construction phase, which generally lasts about five years and provides some 2500 person-years of employment, or a total of 6000 person-years of direct and indirect employment.

At the associated mine sites there is an additional requirement for labor, including field mining crews, administrative staff and personnel engaged to erect drag lines and install shovels.

The permanent population impact is greatest once the plant becomes operational. Coal-fired plants have a lifespan of at least 30 years, during which they provide a stable economic benefit for nearby communities.

Since approximately 90 percent of the people employed by the generating station transfer to the station from elsewhere, a community can expect a total increase of approximately 600 people (including families) when a generating plant is built in the area.

Direct regional economic benefits flow to the area from the infusion of payroll (typically about $10 million a year in 1988 dollars from the generating station itself, plus the payroll associated with mining activity) and from other expenditures for goods and services.

In addition, a major facility provides a significant property tax base to the community or the municipal district. Such taxes run in the order of $5.5 million dollars annually.

The majority of the thermal generating facilities in Alberta are located in regions where the economy is based on agriculture. Mined land is taken out of production for a period not usually exceeding five years. The majority of the land is purchased from land-title holders and returned to agricultural (or some other) use after it has been mined.

Chapter Four

Projections of Electric Demand

Overall Growth in Demand

One of the key concerns of the electric industry is to ensure that enough generating and transmission capacity exists to serve customers, not only now but as demand grows in the future. As noted earlier, co-ordinated planning by Alberta's utilities is carried out through the Electric Utility Planning Council (EUPC).

The EUPC prepares an annual long-term assessment of future electric load growth in the province. There are many uncertainties associated with forecasting electric requirements, particularly as a result of the sensitivity of electric load in Alberta to the world price of oil.

The utilities spend a great deal of time defining the extent and nature of the uncertainty that planners face.

Work done by the EUPC in 1989 indicates that reasonable planning guidelines are bounded (on the up side) by a growth rate averaging 4.4 percent a year over the next 10 years, and (on the down side) by a growth rate averaging 2.4 percent a year.

Table 1 indicates that these growth rates could translate, in the high scenario, into a peak demand of approximately 9,100 MW – 1,900 MW more than the peak under the low scenario.

Table 1. Load Growth Scenarios Based on 1989 EUPC Forecast Bounds
Provincial Peak Demand (in megawatts)

Year	Low (MW)		High (MW)
1988 (actual)		5398	
1990	6014		6216
1995	6726		7806
2000	7193		9082
Average annual growth 1990-2000	2.4%		4.4%

Source: EUPC Forecast Bounds Projected From 1990

Areas of Forecast Uncertainty

The low and high scenarios in Table 1 reflect a range of possible outcomes associated with a range of crude oil prices, from U.S. $15 (in 1988 dollars) to $31 a barrel by the year 2000. However, they also reflect the magnitude of uncertainty that exists due to factors other than oil prices.

Such uncertainties exist in every aspect of the forecasting process. However, they are concentrated in the following areas:

A. Commercial Electric Requirements — Commercial requirements could vary from the levels in the scenarios either through varying rates of economic growth (causing variations in the additions of commercial floor space) or through changes in the amount of electricity used per unit of floor space.

B. Natural Gas Prices — Even if an assumed oil price path turns out to be correct, electric requirements could vary because of changes in the relationship between oil and gas prices. A large part of this uncertainty relates to regulatory decisions or the outcome of ongoing discussions regarding discount sales to core gas markets.

Gas prices affect electric demand, since natural gas and electricity can be substituted for one another in uses such as gas-plant and gas-pipeline compression, irrigation, oilfield injection motors and domestic heating. The relative pricing of the two sources of energy affects consumer choice.

C. Load Factors — The forecast of peak demand (i.e., the maximum demand on the system at any one point in time) depends on the forecast of overall energy requirements and on system load factors (i.e., the percentage of the peak demand that is required, on average, throughout the year).

Load factors for the Alberta Interconnected System, which are approximately 75 percent, are higher than those for many other electric grids. This is due to the fact that a high percentage of our electric energy is used by industrial customers, and is less subject to the rising/falling use pattern typical of residential customers.

Forecast uncertainties are related to the ultimate limit of load factors, the rate at which they are likely to increase, and the impact of rate structures that encourage industrial customers to manage their demand during times of system peak.

D. Major Industrial Loads — Both the magnitude and timing of major loads (in the 50- to 200-megawatt range) are critical for planning the electric system.

Looking out 5 to 15 years, it is difficult to envision the size and quantity of major industrial projects that will be connected to the electric grid. This uncertainty is compounded by the difficulty of forecasting the exact year these projects will appear. The utilities are fairly confident that the number and types of plants they include in the various scenarios adequately reflect Alberta's prospects.

E. Other — A number of other uncertainties would have less individual impact but could be collectively significant:

1) Long-term trends indicate a possible drop in oilfield load as conventional pools are depleted. While this possibility has been reflected in the scenarios, the mechanisms linking declines in conventional oil production to electric use are not yet completely understood.

2) Variation in economic activity could cause variation in the assumed levels of migration to the province.

3) Various levels of government spending could influence the level of economic activity, whether through economic diversification programs, subsidies to agriculture, taxation policies or deficit-reduction policies.

The Impact of New Technologies

The opportunities for development of the electric utility industry in a way that is both sustainable and in harmony with environmental protection have expanded into exciting and innovative territory in the last 10 years. Technology now allows

us to extract more kilowatt-hours of electrical energy from a given quantity of raw resource, whether that resource is wind, water, coal, oil or gas.

As well, the opportunities for more efficient transmission and distribution of electrical power are improving. The introduction of super-conductors, lasers and microtechnology will eventually improve the conservation of our primary resources as well as of electricity.

Utilities have already taken an aggressive role in promoting the conservation of power in residences and businesses, through public awareness campaigns and advertising. Through the use of insulation, electric timers and the wise use of electricity in our everyday lives, we are conserving vital resources and the environment.

Chapter Five

Achieving Sustainable Economic Development

Alberta's electric utilities believe the conservation strategy should recognize the prudent use of non-renewable resources. In other words, the strategy's overall objective should not be the absolute conservation of non-renewable energy resources. The EUPC supports development of Alberta's resources in such a way as to achieve economic growth without compromising the environment.

While the EUPC agrees that a conservation strategy should provide a consistent framework for the long term, it will be essential to review the strategy regularly to ensure it continues to be compatible with changes to social, economic, environmental and technological conditions in Alberta.

Alberta's electric utilities are committed to supplying reliable electricity to the consumer at the lowest possible cost while maintaining high standards of environmental quality consistent with government requirements. This commitment requires long-term planning. Not only do major generation plants and transmission lines require long lead times, but they also have long lifespans.

Coal-Fired Generation

Currently, more than 90 percent of Alberta's electrical generation comes from coal. While coal is a non-renewable resource, it can remain an economic option for electrical power in Alberta for decades to come without prejudicing the objective of sustainable economic development. This is due to several reasons:

1) There are abundant reserves of low-grade, sub-bituminous coal underlying the Alberta plains. An estimated 30 gigatonnes has been identified as readily available — enough to meet Alberta's present electric demand for 1,000 years.

2) While acid-forming gases produced through coal combustion have posed serious threats to sustainable development in other parts of the continent, recent research indicates that similar problems are unlikely in Alberta.

   First, plains coal is lower in sulphur content. As well, the areas of Alberta subject to power plant emissions are known to have a low sensitivity to acid emissions because of the alkaline soils. Finally, the emission of acid-forming gases can be reduced if necessary through technologies now available or under development. (See pages 19-21.)

3) Successful land reclamation is now being demonstrated at power plant mine sites. Current provincial guidelines require that land be returned to a level of productivity at least equal to that which existed before mining took place — a requirement that is being successfully met.

4) The use of coal for power generation can be concentrated in a relatively small number of large plants located in rural areas. This not only affords economies of scale, but also confines emissions to a limited number of points where advanced pollution-control technologies can be used to minimize the impact. The resulting electric energy distributed to the consumer is clean at the point of use — a considerable advantage

over other energy forms such as motor vehicle fuels.

5) Capacity needed to meet peak loads can be provided economically from gas turbines or hydro sites. Peaking units must be available almost instantaneously to meet changes in demand; but, since they do not operate many hours in a year, their fuel costs are less important in comparison with those of the units that provide base load.

Carbon dioxide (CO_2) emissions are being raised as a concern in connection with global warming. All fossil fuels release CO_2 when they are burned.

While thermal generation from coal and gas is currently the most economic option for generating power in Alberta, there is currently no practicable, commercially available technology for removing and disposing of the large quantities of CO_2 produced during combustion.

Governments should set realistic and technically feasible targets for controlling CO_2, while stimulating the development of new technology. Such stimulation should harness market-place forces as much as possible, rather than relying on government-mandated development.

Pollution Control Technologies for Coal-Fired Generation

Various options exist for controlling the emission of pollutants from coal-fired plants. While such technology is available, it is often very expensive — an expense that finds its way into the rates paid by electric consumers.

Therefore, it becomes important to balance the desire for absolute purification of emissions against the cost to customers and also the environment's capacity to cope with small amounts of pollutants without experiencing damage.

The major pollutants to be removed from stack emissions are sulphur dioxide (SO_2) and oxides of nitrogen (NOx) As mentioned earlier, carbon dioxide is emerging as a concern in connection with global warming.

Technology for dealing with CO_2 is not yet available; the major challenge is not so much removing the gas from stack emissions, but disposing of the large amounts of material that would result.

The available pollution control technologies for SO_2 and/or NOx include:

Flue-Gas Desulphurization — Flue-gas desulphurization (more commonly known as "scrubbing") works on the principle of passing the flue gases from the boiler through limestone before allowing them to escape into the atmosphere. The chemical interaction between lime and the sulphur in the flue gases forms calcium sulphate (limestone).

"Wet" scrubbing produces a thick slurry, while "dry" scrubbing produces a solid cake of calcium sulphate.

Scrubbers are expensive devices that can add $150 per kilowatt to the capital cost of a typical coal-fired plant, as well as adding to the plant's ongoing operating costs.

Selective Catalytic Reduction — Selective catalytic reduction (SCR) removes NOx from emissions. It involves the injection of ammonia into the flue gas, which reacts with nitrous oxides in the presence of a catalyst to form nitrogen and water. The technology has been installed on a number of plants in Europe and Japan.

The SCR systems installed in Europe are generally designed to remove between 65 and 80 percent of oxides of nitrogen in the flue gas. SCR is also expensive, with capital costs ranging of up to $150 per kilowatt. If SCR and scrubbing were both added to a plant to remove SO_2 and NOx it would increase the cost of building the plant by 25 percent, as well as increasing lifetime operating costs.

Fluidized Bed Combustion — In fluidized bed combustion (FBC), pollutants are removed where they are formed, right in the furnace.

This technology has advanced considerably over the past decade. The first generation of FBC plants did not fully meet the requirements for reliable operations. However, the next generation of plants (including the variation known as multi-bed combustion) are approaching the stage of

commercial acceptance for industrial and utility applications.

This approach tends to be more efficient than removing SO_2 and NOx from flue gases. Sulphur dioxide emissions are controlled by injecting powdered limestone into the combustion bed, while the lower combustion temperatures and optimal amounts of air keep the production of oxides of nitrogen to a minimum.

Fluidized bed systems can be installed in new plants, and also retro-fitted onto older plants to extend their useful life. This technology is not yet being used in utility-scale operations, so the costs associated with it are still unclear.

Low-NOx-SOx Burners — TransAlta Utilities and Alberta Power are participating in a demonstration project using a low-NOx-SOx burner.

This technology uses an innovative combustion process to burn pulverized coal and remove a major portion of the sulphur dioxide and oxides of nitrogen that are produced when coal is burned.

Studies have shown that this burner can be integrated into new or existing coal-, oil- and gas-fired furnaces. Once again, the costs associated with utility-scale use of this technology are not yet known. However, they are expected to be considerably less than conventional flue gas cleanup technologies.

Integrated Coal Gasification Combined Cycle — Coal gasification involves heating coal to release synthetic gas, and burning this gas to generate electricity. A combined-cycle generating unit adds a second phase to recover waste heat, thereby making more efficient use of energy.

CO_2 emissions are typically 10 to 15 percent lower using gasified coal as opposed to direct coal-fired technology. This technology also offers better economies for removing CO_2 than conventional coal combustion technologies.

Hydro Generation

Hydroelectric developments have definite attractions. They offer a clean, renewable source of electricity with no emissions or waste-disposal problems. Hydro generation is flexible and responsive to fluctuations in electric demand.

While hydro developments have very high capital costs, their operating costs are minimal in the long term, and they have an life expectancy of 50 to 70 years.

Hydroelectric developments undoubtedly have environmental impacts. Impoundment of water for hydro dams creates permanent change to the landscape which can only be reversed with the removal of the dam and the drainage of the reservoir. The amount of land affected depends on the size of the river valley involved.

Although mixed land uses are removed when an area is flooded, the reservoir itself provides recreation opportunities and water supply opportunities. Hydro projects can be put to multiple uses, such as control of downstream river flows as well as generating power. For urban centres, the regulation of downstream water flows can help reduce flood potential, enhance downstream fisheries, reduce urban waste disposal impacts on downstream receiving waters, and supply water for irrigation and domestic consumption.

At the moment, Alberta has about 800 MW of hydroelectric capacity, located primarily on the Bow River System west of Calgary, on the Brazeau River and on the North Saskatchewan River. However, Alberta has relatively little potential for new large-scale, economically attractive hydro development.

Two major projects that have been looked at in the past are Dunvegan (on the Peace River near the Dunvegan Bridge) and the Slave River hydro development (on the Slave River near Fort Smith in the Northwest Territories).

While these sites have a potential of 1000 MW (at Dunvegan) and 1800 (on the Slave), the economics of developing them do not compare favorably with coal at this point. Both sites would require major construction of transmission lines to tie them into the Alberta Interconnected System.

Gas-Fired Generation

Another resource available in Alberta for generating electricity is natural gas. At the moment, there is about 1230 MW of installed, natural-gas-fired

capacity in the province, which is used largely for meeting peak demand and reserve requirements. As well, the City of Medicine Hat, which owns natural gas wells, meets much of its electric requirements with this type of generation.

A few important considerations regarding the use of natural gas include:

1) Natural-gas-fired plants offer more flexibility, since the time required to put them in place is shorter than for coal-fired plants, and the initial capital cost is lower.

2) The technology currently exists for controlling emissions of oxides of nitrogen. Sulphur dioxide levels are considered negligible in a natural-gas-fired turbine.

3) However, a major drawback to the use of natural gas for thermal generation is the fact that gas prices are higher than coal prices and are subject to much more severe price fluctuations, depending on market conditions. In addition, gas prices are expected to escalate much more than coal prices.

   As a result, ongoing operating costs are higher and vulnerable to fluctuations in fuel cost. This fact can negate the fact that initial capital costs are lower for gas-fired units.

Other Generation Resources

Options such as wind and solar power have great appeal because of potential for the limitless renewable source of power for the generators. However, for electricity generation on the scale required by consumers in Alberta, such resources have characteristics that can limit their use.

One drawback is that sunshine or wind are fluctuating resources, and not always available when people need electricity. This means that some form of energy storage (such as batteries or impounded water) is needed as a back-up for this type of generation.

As well, when it comes to generating electricity on the scale required to serve large numbers of Albertans, solar and wind power would present their own environmental problems. Vast areas of land would have to be committed to windmills or solar panel sites, posing problems of aesthetics and, (in the case of windfarms) noise levels caused by the turning blades.

Nuclear energy offers some environmental trade-offs. On the one hand it avoids the environmental concerns associated with burning fossil fuels; on the other, the disposal of radioactive waste remains an area of concern. Nuclear energy is not at this point considered a practical option for the Alberta system.

The availability and use of energy resources including wind, water, wood, coal, oil and gas are addressed in separate sector reports published as background documents for the conservation strategy and will not be dealt with at length in this submission.

Cogeneration and other waste-heat recovery are also possible alternatives that deserve exploration, although they are limited in capacity. They could meet some increase in demand, but not all.

The raw energy resource trade-offs that confront Alberta must be continually reviewed and refined to insure that new generating capacity is based on the mix of existing capacity and future needs that is most acceptable to Albertans.

Transmission Lines

In general, generation facilities are considered to have the greatest impact on the quality of the environment. However, the transmission lines needed to deliver electricity to consumers also have an impact on the quality of the environment.

The principal concerns tend to focus on aesthetic concerns and the removal of land from other productive uses by power-line rights-of-way. One of the key resources affected is agricultural land.

While there are some 150,000 km of power lines (including transmission and distribution lines) throughout the province, they remove very little land from agricultural production. Most lines are located along existing road allowances. And, even where rights-of-way are located on agricultural land, only the area immediately surrounding the transmission towers or poles cannot be farmed.

A 1985 study (EUPC 1985) of the impact of electric utilities on Alberta's land base indicated

that approximately 400 hectares of land had been removed from the agricultural land base for power lines and substations.

Other land base resources potentially affected by proposed power line corridors include forestry, trapping and fish and wildlife. Other environmental land use concerns such as ecological reserves, natural areas, parks, campgrounds and archaeological sites are also taken into consideration at the right-of-way planning stage.

Biophysical Impacts

The biophysical environment is not affected by electrical transmission, although in recent months, some media attention has been focussed on electric and magnetic fields and their potential impact on human health.

In fact, hundreds of studies on the issue have been funded over the past 20 years by government agencies, universities and utilities. The consensus in the scientific community (including the World Health Organization and Health and Welfare Canada) is that it is very unlikely that there is any public health risk from exposure to electric and magnetic fields, although scientists agree that further research is needed to confirm this finding (Repacholi et al. 1985 and 1988).

Research has focussed on three primary areas: basic science (in which laboratory researchers have investigated the effect of fields on cells and animals); epidemiological studies (in which scientists look for statistical correlations between health patterns in a large group of people and factors that may influence those patterns) and exposures (in which researchers measure the extent to which people are typically exposed to fields in various home and job settings).

Researchers have determined that electric and magnetic fields can stimulate a response in some cells and animals. However, these responses have not been shown to be harmful. They are, in fact, used beneficially in a number of medical applications.

Surveys of beef ranchers and dairy farmers who graze animals beneath high-voltage lines confirm that these animals grow as quickly, produce as much milk and bear healthy offspring at the same rate as those on other farms (Algers and Hultgren 1985; Lee et al. 1982).

In the area of human health, some early studies seemed to find a link between electric and magnetic fields and human health, but were subsequently found to be inaccurate. These early studies did prompt additional, more careful research.

Some of the most recent and authoritative research was conducted under a five-year, $5-million project set up by regulatory authorities in New York State. The project funded 16 research studies at various universities, the results of which were released in 1987.

Fifteen of these studies found nothing to link adverse health effects to electric and magnetic fields. The 16th, an epidemiological study conducted by Dr. David Savitz of the University of North Carolina, produced inconclusive results.

His research suggested a possible weak link between childhood leukemia and residence near power lines. His research indicated that the rate for such leukemia could increase from one case in a population of 10,000 to 2 cases (Savitz 1987).

Dr. Savitz, in an open letter about his research, says that it does not prove that fields cause leukemia, and says, "Subsequent research will indicate whether we are on the right track or whether our results are in error."

Chapter Six

Legislation And Regulatory Regime

Overview

Alberta has regulatory processes covering the construction of electrical facilities so that the environment is protected.

The Hydro and Electric Energy Act's major purposes are to provide for the economic, orderly, safe, and efficient development and operation in the public interest of generation and transmission while assisting the government to control pollution and ensure environmental conservation.

Pursuant to this legislation, the construction of all generating plants in Alberta must be approved by the Energy Resources Conservation Board (ERCB). In addition, Cabinet approval is required for any power plant, except for fossil-fueled plants less than 15 megawatts in capacity.

Similarly, the same legislation requires ERCB approval for the construction of all transmission lines, unless the owner is transmitting electricity for his own use and does not cross any public highways.

Applications to the ERCB are referred to Alberta Environment for review and to the Minister of the Environment for approval regarding environmental matters. In the case of hydro developments and transmission lines on Crown lands, applications are also referred to the Minister of Forestry, Lands and Wildlife for approval.

The ERCB may hold a public hearing on any application, and such hearings are normal for all major projects. During the hearing, all concerned stake-holders have the opportunity to review the application and to cross-examine the proponent while submitting their own intervention. The proponent is usually also cross-examined by Alberta Environment and ERCB representatives.

The ERCB project approval process is, as a result, an integrated process where all technical, environmental, economic, and social issues are considered together with the participation of all interested parties.

After the approval of a project by the ERCB (which includes approval by the Minister of the Environment, and, where necessary, the Minister of Forestry, Lands and Wildlife) the project proponent may proceed with construction, subject to obtaining all necessary detailed approvals for various components of the project. This stage includes all the environmental approvals.

Approval of Generating Plants

Almost all the generating capacity approved by the ERCB since 1970 is coal-fired generation, based on mine-mouth power plants. The approval process for mine-mouth coal-fired projects follows the basic ERCB process but is complicated by the inclusion of the mine. All projects are consequently subject to the Alberta Coal Policy (1976) and the Coal Conservation Act, which means that a preliminary disclosure stage is added to the process.

The Coal Conservation Act is intended to ensure the orderly, efficient, economic, and safe development of Alberta's coal resources while preventing waste of coal resources, and assisting the government to control pollution and ensuring environmental conservation.

Approval of Transmission Lines

Major transmission projects (69 kilovolts and higher) are also subject to the ERCB process.

Alberta's surface rights compensation legislation ensures that farmers do not sustain short- or long-term economic losses due to loss of production opportunities from development.

Right-of-way planning for transmission power lines, and to a lesser extent, distribution power lines, is a detailed process involving the following major phases:

- Assembling up-to-date information, including mapping and aerial photography, to produce a base plan detailing the various degrees of constraints on routing a transmission line corridor.

Locating route options to avoid or minimize adverse effects from the point of view of social, environmental, land-use, technical and regulatory factors.

- Soliciting informed input from all parties who have an interest in lands potentially affected by proposed transmission lines.
- Obtaining regulatory approval for a transmission line.
- Working with all directly affected parties throughout the construction process.

Emission Standard Status

Over the past two decades, electric utilities have made major strides in reducing emissions from coal-fired power plants to meet provincial standards. As one example, the efficiency of fly-ash removal from stack gases has increased from less than 85 percent to more than 99.5 percent, due to the investment of hundreds of millions of dollars in electrostatic precipitators.

The combustion of low-sulphur coal (the average sulphur content of plains coal ranges between 0.2 and 0.6 percent, compared with between three and six percent for coal found in eastern parts of North America) ensures low sulphur-dioxide emissions compared with similar plants in central or eastern Canada. Continuing improvements in boiler design have reduced the emission of oxides of nitrogen to levels below Canada's National Emission Guidelines.

The findings of the Acid Deposition Research Program, released in July, 1988, indicate that acid gases are not demonstrably harming the Alberta environment. This research program was carried out by a team of independent researchers and provided valuable base-line data about air quality in Alberta.

Although the research program did not find problems, it appears that even more stringent standards may be imposed. There is an increasing tendency for international forums to agree on more stringent environmental standards for air emissions.

These initiatives are important where global environmental issues are at stake or where countries are subject to significant transboundary pollution. However, some pollution concerns have a more limited impact. For instance, according to a recent assessment by the Acid Deposition Research Program, Alberta does not share the sensitive ecosystem concerns of many other areas of the world affected by acid rain.

Government standards should reflect local conditions as well as global concerns. In Alberta, spending the large amounts of money necessary to further reduce acid emissions would probably not make the most effective use of our financial resources to achieve an improved environment.

Chapter Seven

Conclusions

The EUPC recommends that a Conservation Strategy for Alberta should consider the economic role played by electricity, both as an industry in itself and as an essential ingredient in other industrial development.

Two main conclusions can be drawn from this submission:

1) Coal-fired generation will likely remain the primary economic source of electric generation for Alberta, even when technologies for improving environmental performance are taken into consideration. Alberta's utilities will continue to monitor, develop and implement technologies to burn coal cleanly, but a Conservation Strategy must recognize the importance of this resource.

2) The existing regulatory regime in Alberta has protected the environment. Regulations will no doubt be adapted to cope with changing environmental priorities and new technologies. However, the regulatory system must recognize the long lead times required to build or change electric facilities.

The EUPC and its member utilities feel strongly that the sensible use of our resources can achieve sustainable economic development without compromising the quality of the environment.

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Appendix A

Electric Service in Alberta: Historical Background

Alberta's unique combination of electric utilities is the result of more than a hundred years of development in the electric business.

Service to the province's two major cities goes back before the turn of the century. The history of electric development in Alberta began in 1887, when the Calgary Electric Lighting Company first provided Calgarians with power. In Edmonton, the first electric service was provided in 1891, from a 450-kilowatt generator fueled by coal from local collieries.

In the early decades of the century, a typical electric system in the towns and villages of Alberta would consist of a small coal- or oil-fired engine owned by a local entrepreneur. These small, isolated systems would serve up to a few hundred customers.

Typical hours of operation would be from dusk to midnight each day, as well as during the day on Mondays so that housewives could do laundry. Almost all the load was made up of residential customers, with very few commercial or industrial applications, and the cost of electricity ranged around 25 cents a kilowatt hour.

In Edmonton and Calgary, a significant amount of the early load was required by the cities' electric streetcar systems. (Edmonton's streetcar system, for instance, was installed in 1908.)

Foundation of the Investor-Owned Utilities

In 1909, the forerunner of TransAlta Utilities was established by Max Aitkin (later Lord Beaverbrook) and a future prime minister, R.B. Bennett. The fledgling company's first project was to finance and build the Horseshoe Falls Hydro Plant on the Bow River.

In 1911, the Calgary Power Company Limited (as TransAlta was then known) signed a contract to supply the City of Calgary with power. In 1913, the company built another hydro plant at Kananaskis Falls to meet the growing load. During the 1920s, Calgary Power bought the electric systems in a number of communities, such as High River, Taber, and Vulcan, and began linking them together with a transmission system.

Alberta Power's history goes back — under the name Canadian Utilities — to 1927, when the company bought a small generating system in Vegreville. In the years shortly thereafter, Canadian Utilities rapidly acquired franchises to serve communities in Alberta and Saskatchewan. (Drumheller and Grande Prairie were among the franchises acquired during the company's first year.) Development quickly fell into a pattern: as transmission lines were extended, small, local plants were scrapped or placed on standby.

The Depression years put a brake on the growth in electric demand that had characterized the 1920s. Canadian Utilities operated at a loss until 1935, while the capacity of Calgary Power's Ghost hydro project (completed in the same year as the stock market crash) went largely unused for a number of years.

During the 1930s, both companies instituted marketing campaigns to build electric sales by increasing the use of electric appliances. Travelling displays were taken to towns and villages to demonstrate the newest in electrical conveniences and sell appliances.

Farm Electrification

Electric service came relatively early in the century to the cities and towns of the province. But it was extended much more slowly to rural areas. Calgary Power had tried an unsuccessful farm electrification program in 1928, but by 1941, only 5 percent of Alberta farms had electric service of any kind — including that provided by gasoline and wind-power plants.

World War II helped spur demand for rural electrification. Traditional sources of labor dried up as men went off to enlist in the armed forces, while at the same time the demand for agricultural productivity was increasing.

The main obstruction to large-scale rural electrification was cost. The capital investment needed to extend thousands of kilometres of distribution lines throughout the province in the mid 1940s was estimated to be $200 million, more than twice the provincial debt at the time.

Joint studies by the utilities and the provincial government led to a series of experimental farm electrification projects — the first built by Canadian Utilities at Swalwell in 1944 — and to legislation passed by the provincial government. Under the government's rural electrification program, farmers formed co-operatives. Financed in part by the farmers themselves and up to half by government loans, these rural electrification associations (REAs) owned their own distribution systems.

Under the REA program, Canadian Utilities alone brought service to 5,200 farms and built 6,700 km of power line within a 10-year period. Rural electrification in Alberta continued vigorously throughout the 1950s.

The Switch To Coal

Throughout the early years, Canadian Utilities generated power for its customers from coal (at its Drumheller plant) and gas or oil. Edmonton Power used coal in its boilers at the Rossdale Station — at 60 MW, it was Canada's largest thermal generating station in 1941.

Nevertheless, the largest single component of the province's generating capacity until the 1950s was hydro power from Calgary Power's units. But by the time the Spray River development was completed in the early 1950s, few economic sites remained for hydro development. At the same time, electric demand was growing strongly in the post-war years. And in 1947, when Leduc Number One blew in, an era of rapid petroleum development for Alberta began.

In 1956, Canadian Utilities built the first unit of its Battle River generating station — a 32-megawatt coal-fired unit that virtually doubled the company's previous generating capacity. That same year, the first unit of Calgary Power's Wabamun plant went into service. The unit was gas-fired, but as later units were added to the plant, the Whitewood coal mine was opened to supply them and the original unit converted to coal.

Through the 1960s and 1970s, the province's utilities turned increasingly to coal. Calgary Power began building its second thermal generating facility, the Sundance Generating Plant in 1967, while a fourth unit was being built at Wabamun. Canadian Utilities added additional units to its Battle River plants in ever-increasing sizes. Unit 3 was bumped from 60 megawatts to 150 megawatts while it was still on the drawing board.

Hydro power was still being added to the system. Calgary Power commissioned the first turbine at the Brazeau multi-use hydro facility in 1965, and built the Bighorn dam in 1972. Hydro power provides the grid with valuable flexibility in meeting peak loads.

Nevertheless, the addition of still more coal-fired units — most recently at TransAlta's Keephills plant, at the Sheerness generating station jointly owned by TransAlta and Alberta Power, and at the Genesee plant owned by Edmonton Power — means that coal-fired generation dominates the Alberta Interconnected System.

The 1980s

Alberta's utilities were hard-pressed to keep up with the province's economic growth during the boom years. Growth in electric sales during the 1970s was more than 8.5 percent per year — double the U.S. average for the same period.

In the early 1980s, recession hit the province's economy hard, with a corresponding impact on the electric industry. Nevertheless, the demand for electricity has continued to grow. The growth in annual electric sales, averaging more than five percent during the 1980s, still outstrips the rest of Canada and the United States. Nevertheless, growth is undoubtedly slower than it had been during the 1960s and 1970s.

Perhaps the greatest impact of recession and of fluctuating oil prices on the electric industry in this province has been the complexity they have introduced into the process of planning to meet future load growth. The relatively straightforward single-line forecasts that could be developed in the last decade have to be replaced by a variety of scenarios based on various economic contingencies.

Over the past century, electricity has grown from a novel convenience to an integral component of Alberta's society. Today — whether in school or a hospital, a home or an office — it is virtually impossible to imagine doing without it. Nevertheless, from the early days when utilities vigorously promoted the use of electricity to help them survive, to the energy-conservation era ushered in by the energy crisis, the patterns of electric use and attitudes towards environmental issues have altered significantly.

Alberta's utilities are aware of and have responded to increasing public awareness about the impact of utility operations on people and the environment.